CLAIMS

What is claimed is:

1. A nanosphere having a diameter less than 300 nanometers, the nanosphere comprising:

at least one magnetically responsive nanoparticle having single domain properties; and

a bio-compatible shell encapsulating the nanoparticle.

2. The nanosphere of claim 1 wherein the at least one magnetically responsive nanoparticle comprises a plurality of magnetically responsive nanoparticles having single domain properties.

3. The nanosphere of claim 2 wherein the plurality of single domain magnetically responsive nanoparticles have uniformly aligned magnetic moments.

4. The nanosphere of claim 1 wherein the nanoparticle is comprised of a ferrite.

5. The nanosphere of claim 1 wherein the nanoparticle is comprised of magnetite.

6. The nanosphere of claim 1 wherein the nanoparticle comprises a silica coating.

7. The nanosphere of claim 6 wherein the nanoparticle comprises magnetite.

8. The nanosphere of claim 7 further comprising an erodable polymer contained within the bio-compatible shell.

9. The nanosphere of claim 1 wherein the bio-compatible shell comprises a biostable polymer.

10. The nanosphere of claim 9 wherein the biostable polymer comprises at least one of silica or titania.

11. The nanosphere of claim 9 further comprising cell adhesion factors supported on the bio-compatible shell.

12. The nanosphere of claim 9 wherein the nanosphere comprises a plurality of single domain magnetically responsive nanoparticles having uniformly aligned magnetic moments.

13. The nanosphere of claim 11 wherein the nanoparticles are comprised of magnetite.

14. The nanosphere of claim 1 further comprising an erodable polymer matrix encapsulated within the bio-compatible shell.

15. The nanosphere of claim 14 further comprising a therapeutic encapsulated within the bio-compatible shell.

16. The nanosphere of claim 1 wherein the bio-compatible shell comprises collagen.

17. The nanosphere of claim 16 further comprising a therapeutic encapsulated within the bio-compatible shell.

18. The nanosphere of claim 17 further comprising an erodable polymer matrix encapsulated within the bio-compatible shell.

19. The nanosphere of claim 18 wherein the nanosphere comprises a plurality of single domain magnetically responsive nanoparticles having uniformly aligned magnetic moments.

20. The nanosphere of claim 19 wherein the nanoparticle is superparamagnetic.

21. The nanosphere of claim 1 wherein the bio-compatible shell comprises an outer surface and wherein the nanosphere further comprises at least one cell adhesion factor supported on the outer surface of the bio-compatible shell.

22. The nanosphere of claim 21 wherein the cell adhesion factor comprises a protein having an affinity for a predetermined cell.

23. The nanosphere of claim 1 wherein the nanoparticle is superparamagnetic.

24. A nanosphere having a diameter less than 300 nanometers comprising:

at least one magnetically responsive nanoparticle prepared by a process comprising:

vaporizing a magnetic metal salt;

oxidizing the vaporized magnetic metal salt to produce an oxidized metal vapor; and

quenching the oxidized metal vapor; and

a bio-compatible shell encapsulating the nanoparticle.

25. The nanosphere of claim 24 wherein the magnetic metal salt comprises a ferric and ferrous mixture having a ratio of between 2 to 1 and 10 to 1.

26. The nanosphere of claim 24 wherein the process further comprises injecting the vaporized magnetic metal salt into a plasma reactor.

27. The nanosphere of claim 26 wherein the nanosphere further comprises a plurality of nanoparticles and the process further comprises nucleating the nanoparticles.

28. The nanosphere of claim 27 wherein the process further comprises treating the nanoparticles with a bio-compatible surface agent.

29. The nanosphere of claim 28 where in the bio-compatible surface agent comprises silicon tetrachloride.

30. The nanosphere of claim 28 wherein the quenching the oxidized metal vapor further comprises injecting a cooling gas.

31. The nanosphere of claim 30 wherein the process further comprises collecting the nanoparticles using an electrostatic filter.

32. The nanosphere of claim 24 wherein the process further comprises introducing silicon tetrachloride to the oxidized metal vapor.

33. The nanosphere of claim 24 wherein the nanoparticle is comprised of magnetite.

34. The nanosphere of claim 24 wherein the bio-compatible shell is comprised of collagen.

35. The nanosphere of claim 34 further comprising an erodable polymer matrix contained within the bio-compatible shell.

36. The nanosphere of claim 35 further comprising a therapeutic contained within the bio-compatible shell.

37. A nanosphere having a diameter of less than 300 nanometers comprising:

at least one magnetically responsive nanoparticle having single domain properties prepared by a process comprising:

forming a precipitate by mixing a magnetic metal salt and an alkaline media;

magnetically collecting the precipitate; and

drying the precipitate;

a bio-compatible shell encapsulating the nanoparticle.

38. The nanosphere of claim 37 wherein the magnetic metal salt comprises ferric chloride and ferrous chloride at a ratio of between 2 to 1 and 10 to 1.

39. The nanosphere of claim 37 wherein the alkaline media comprises ammonium hydroxide.

40. The nanosphere of claim 37 wherein the process of preparing the nanoparticles further comprises washing the precipitate with a solvent.

41. The nanosphere of claim 37 wherein drying the precipitate further comprises heating the precipitate.

42. The nanosphere of claim 37 wherein the process of preparing the nanoparticles further comprises dispersing the precipitate in an alkaline media.

43. The nanosphere of claim 42 wherein the process further comprises reacting the precipitate with sodium silicate.

44. The nanosphere of claim 42 wherein the process further comprises reacting the precipitate with a chloride salt.

45. A method for making a magnetically responsive nanoparticle comprising:

vaporizing a magnetic-metal salt;

oxidizing the vaporized magnetic-metal salt to produce an metal oxide vapor; and

quenching the metal oxide vapor to produce at least one nanoparticle of a desired diameter.

46. The method of claim 45 wherein the magnetic metal salt comprises a ferric and ferrous mixture having a ratio of between 2 to 1 and 10 to 1.

47. The method of claim 45 wherein the oxidation step is carried out using a plasma reactor.

48. The method of claim 47 further comprising treating the surface of the nanoparticle with a bio-compatible surface agent comprising silicon tetrachloride.

49. The method of claim 45 further comprising collecting the nanoparticle with an electrostatic filter.

50. A method for making a magnetically responsive nanoparticle comprising:

forming a precipitate by mixing a magnetic metal salt and an alkaline media;

collecting the precipitate using a magnetic field; and

drying the precipitate.

51. The method of claim 50 wherein the magnetic metal salt comprises a mixture of magnetic metal salts comprising ferric chloride and ferrous chloride at a ratio of between 2 to 1 and 10 to 1.

52. The method of claim 50 wherein the alkaline media comprises ammonium hydroxide.

53. The method of claim 50 further comprising washing the precipitate with a solvent.

54. The method of claim 50 wherein drying the precipitate further comprises heating the precipitate.

55. The method of claim 50 further comprising the steps of:

dispersing the precipitate in alkaline media; and

reacting the precipitate with sodium silicate.

56. A magnetically responsive nanosphere having a bio-compatible shell, the nanosphere is prepared by a process comprising:

atomizing a nanodispersion wherein the nanodispersion comprises a magnetically responsive nanoparticle and sodium silicate; and

drying the atomized nanodispersion in a magnetic field.

57. The nanosphere of claim 56 wherein the nanosphere comprises a plurality of magnetically responsive nanoparticles encapsulated within the bio-compatible shell.

58. The nanosphere of claim 57 wherein the nanoparticles comprise magnetite.

59. The nanosphere of claim 56 further comprising at least a therapeutic contained within the bio-compatible shell.

60. The nanosphere of claim 59 wherein the therapeutic further comprises an erodable matrix.

61. The nanosphere of claim 56 wherein the bio-compatible shell comprises an outer surface and wherein the nanosphere further comprises at least one cell adhesion factor supported on the outer surface of the bio-compatible shell.

62. The nanosphere of claim 56 wherein the nanoparticle is superparamagnetic.

63. A magnetically responsive nanosphere having a bioerodable shell, the nanosphere is prepared by a process comprising:

atomizing a dilute solution to form a droplet, wherein the dilute solution comprises at least one magnetically responsive nanoparticle, a solvating media, and a bioerodable polymeric material; and

drying the droplet in a magnetic field to remove the solvating media.

64. The nanosphere of claim 63 wherein the nanoparticle is comprised of magnetite.

65. The nanosphere of claim 63 wherein the dilute solution comprises a plurality of single domain magnetically responsive nanoparticles having uniformly aligned magnetic moments.

66. The nanosphere of claim 63 wherein the nanoparticle is superparamagnetic.

67. A nanosphere having a diameter of less than 300 nanometers, the nanosphere comprising:

a plurality of single domain superparamagnetic magnetite nanoparticles having uniformly aligned magnetic moments;

a shell encapsulating each of the plurality of the nanoparticles; and

an outer bio-compatible shell encapsulating the nanoparticles.

68. The nanosphere of claim 67 wherein the shell encapsulating each of the plurality of the nanoparticles comprises collagen.

69. The nanosphere of claim 67 further comprising:

a bioerodable polymer matrix contained within the outer bio-compatible shell; and

a therapeutic contained within the bioerodable polymer matrix.

70. The nanosphere of claim 67 wherein the shell encapsulating each of the plurality of nanoparticles comprises silica.

71. The nanosphere of claim 70 wherein the outer bio-compatible shell encapsulating the nanoparticles further comprises at least a cell adhesion factor.